APPENDIX B.2. ACCLIMATION FACILITIES

- ALTERNATIVE AND PROPOSED PLAN EVALUATIONS

Yakama Nation Fisheries Resource Management

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I. *SUMMARY*

Mid-Columbia Coho Restoration Program (MCCRP) alternatives for the acclimation component of the project are evaluated and a proposed smolt release plan is described. Guidelines are developed to support the selection of the basic types of systems and specific sites that would form the acclimation plan. The guidelines support the main objective of producing quality smolts that return as adults to habitat areas that will support natural production.

The impact of acclimation systems on overall adult survival rates; return rates to natural production areas; capital and operating costs; flexibility to adapt to changing release numbers, locations, and methods; and site development considerations help determine the program design. Guidelines based on these elements are used to evaluate both general types of acclimation system alternatives and specific sites that comprise those systems.

Acclimation options evaluated in selecting a proposed program conceptual design include:

- Length of acclimation period.
- Number of release locations.
- Location of sites within watershed.
- Type of water supplies.
- Design of acclimation rearing systems.

A comparison of these options based on the selection guidelines demonstrates that a program based on multiple, low density, natural ponds fed by gravity flow surface water is the most cost effective system that meets program objectives. The proposed program emphasizes these types of sites while also including other designs dictated by practical, watershed dependant considerations.

An acclimation system is proposed that has one or more release sites in each of the tributary streams that are targeted for reintroduction. A combined total of 18 release sites are proposed in the Wenatchee and Methow watersheds. Eleven of these sites exist now and do not require significant amounts of construction; many are currently being used by the MCCRP. Of the remaining 7 locations that do require construction, 2 will be used for rearing as well as acclimation/release.

This acclimation system is expected to produce high adult return rates, distribute fish into appropriate habitat, have low overall project costs, and is designed to have the flexibility to adapt to planned and unplanned changes in program release protocols.

II. *INTRODUCTION*

This appendix evaluates program acclimation options. An acclimation plan is selected from these options using siting and design guidelines. The sites proposed for use in the plan are described in detail in appendices C.3 and C.4. The following is a list of master plan facility appendices, with this appendix highlighted.

A. FISH CULTURE GUIDELINES
B. ALTERNATIVE AND PROPOSED PLAN EVALUATIONS
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D. PROJECT SCHEDULE AND COSTS

Plans require the identification of facilities that will acclimate prior to release a total of up to 2,155,000 coho smolts. Release numbers by restoration phase are summarized in the table below.

Table 1. Proposed Acclimation Plan Summary
(*numbers of smolts released*)

	BDP I	BDP II	NPIP	NPSP I	NPSP F
WENATCHEE					
Icicle	750,000	500,000	75,000	50,000	25,000
Beaver and Nason	250,000				
Beaver, Nason, Chiwawa		500,000			
Nason			210,000	147,000	73,500
White			210,000	147,000	73,500
Upper Wenatchee			100,000	70,000	35,000
Chiwawa			440,000	308,000	154,000
Little Wenatchee			120,000	84,000	42,000
BASIN TOTAL	*1,000,000*	*1,000,000*	*1,155,000*	*806,000*	*403,000*
METHOW					
Winthrop NFH	300,000	300,000			
Wells Hatchery	200,000	200,000			
Chewuch			325,000	227,500	113,750
Twisp			275,000	192,500	96,250
Wolf			50,000	35,000	17,500
Upper and Mid Mainstem			350,000	245,000	122,500
BASIN TOTAL	*500,000*	*500,000*	*1,000,000*	*700,000*	*350,000*
REGION TOTALS	***1,500,000***	***1,500,000***	***2,155,000***	***1,506,000***	***753,000***

The plan phase titles are: Broodstock Development Phase I (BDP I), Broodstock Development Phase II (BDP II), Natural Production Implementation Phase (NPIP), Natural Production Supplementation Phase Initial (NPSP I), and Natural Production Supplementation Phase Final (NPSP F).

Current releases are approximately 1,000,000 in the Wenatchee Basin and 300,000 in the Methow Basin. These smolts are released in numbers and at locations required to achieve the objectives of the broodstock development phases. New acclimation facilities will not be required until the natural production implementation phase begins.

III. *SITING AND DESIGN GUIDELINES*

Release locations are proposed based upon conditions that prepare artificially produced fish for success in the wild and that return adults to appropriate habitat. Acclimation sites must also meet other criteria; such as cost effectiveness, functionality, and flexibility. Many of the site specific development criteria for acclimation are similar to those for rearing, which are described in Appendix B.1. Culturing guidelines for both program components are discussed in detail in Appendix A.

An acclimation program involves both a proposed system and specific sites to be used. "Systems" is used as a term for describing various general types of facilities and methods, including options such as the number of sites per watershed, their location, the type of rearing units, and the duration of acclimation. Systems and sites are closely interrelated; the type of facility used is tied to its location. As a result, criteria are developed and used in evaluations of both general program design and individual sites.

A. ADULT SURVIVAL RATES

1. Water Quantity and Quality

The natural temperature profile of surface water is predicted to improve adult return rates (see Appendix A for references). Rising temperatures during the weeks preceding release will be considered a priority for acclimation sites.

Gravity flow is optimal, especially at remote release locations. With gravity flow, the cost of developing water supplies, the risks due to mechanical or power failures, and operating costs may all be reduced.

A standard value for minimum water flow density at average springtime water temperatures will be 6 lbs/gpm (0.7 kg/lpm, or a flow index of 0.05, see Appendix A for details). This assumes a fully oxygen saturated incoming water supply. One-hundred thousand smolts, at 18/lb, require 900 gpm, or 2.0 cfs. Minimum flow quantities are increased for sites where supply interruption risks are higher.

Flooding can potentially impact acclimation sites. Locations where rearing/acclimation is expected to occur through winter can accept less flood risk than short-term acclimation sites since premature escape of smolts is unlikely to impact the project to the extent that early releases of fingerlings or pre-smolts would. Long-term acclimation sites can minimize the risk of premature release by keeping pond berms one foot higher than 100 year flood elevations.

2. Rearing Environment

In general, an environment that mimics nature improves adult survival rates (see Appendix A for details). Acclimation site guidelines include:

- *Minimum volume density*: 0.3 lb/ft^3 (4.8 kg/m^3, or a density index of .05) at release for water supplies with high reliability. 0.1 lb/cft for sites without back-up water supply systems. 100,000, 18/lb smolts, at sites without back-up water supplies, require 55,000 cft, or 14,000 sft at an average depth of 4 ft.
- *Acclimation rearing units*: large ponds.

3. Length of Acclimation

Several studies demonstrate the value of acclimation and compare various acclimation periods. A coho study on the Oregon coast (Johnson et al., 1990) showed higher adult survival rates for fish acclimated for 6 weeks prior to release than for fish truck planted without acclimation. Paired releases of chinook salmon in the Mid-Columbia (Wenatchee, Methow, and Similkameen) have shown significantly higher smolt to adult return rates for fish acclimated on river water for 7 months over those acclimated for 2 months. Over the five year study, the overwinter acclimation period typically resulted in a 200% increase in SARS (A. Murdoch unpublished data). Studies with other species (Isaksson et al., 1978 and Whitesal, 1994) confirm that fish acclimated prior to release survive at higher rates and have improved homing fidelity. MCCRP studies are underway now to evaluate very short and very long coho acclimation periods.

Direct truck plants of smolts have not been successful in establishing large-scale natural populations of coho in the Yakima River. As described in the Yakima Coho Master Plan (Yakima/Klickitat Fisheries Project, 2003), "The Yakama Nation has released between 85,000 and 1.4 million coho smolts in the Yakima basin annually since 1985. However, before 1995, the primary purpose of these releases was harvest augmentation; after 1995, the primary purpose became a test of the feasibility of re-establishing natural production..." Releases in the 1985-1995 time period were mainly direct truck plants in the mainstem Yakima. Beginning in 1995, fish were acclimated for approximately 6 weeks prior to release. As shown in the plot below, also from the Yakima Coho Master Plan, adult return numbers were low until acclimation of smolts was begun.

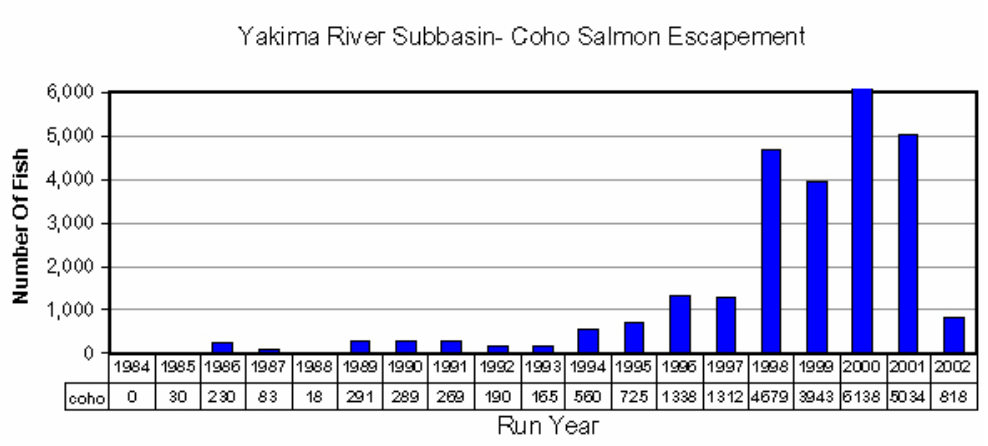

Figure 1. Yakima River Escapement

It is unclear how the pre-smolt, hatchery rearing environment impacts the effectiveness of the length of acclimation. If fish are reared in a low density, semi-natural rearing environment prior to acclimation, some of the advantages of acclimation may be reduced. However, until further information is available, it will be assumed that overwinter acclimation will be a significant benefit.

B. ADULT RETURN LOCATION

A goal of siting acclimation facilities is to return adults to natural production areas. Meeting this goal depends on understanding the behavior of returning adults and identifying the habitat that allows successful reproduction.

1. Dispersal Patterns

If returning adults disperse widely, fewer release locations can be used and their exact siting is not critical. If returning adults disperse mainly below release sites, the release sites should be located in the upper reaches of habitat. Both Mid-Columbia (Murdoch et al., 2004) and Yakima (Bosch et al., 2005) monitoring and evaluation studies are showing that reintroduced coho are widely dispersing in areas downstream of points of release.

Dispersal range is decreasing and adults are moving closer to the release points as locally adapted stocks develop. The expectation is that local adaptation will result in stocks that have traits, such as increased adult energy reserves, that allow greater returns to upstream habitat (Murdoch et al., 2004). However, it is unclear how focused the dispersal patterns will be after full adaptation has occurred. A high degree of homing fidelity to release sites means that location criteria should include acclimation very close to, or in, spawning habitat.

With low survival rates, wide dispersal results in low spawner concentration. Nickelson et al. (1998), in an Oregon coho model, concluded that spawner density (impacted by both dispersal in space and time) was a high extinction risk factor. If survival rates to upstream habitat areas continue at low levels, emphasis on acclimation systems that minimize dispersal may be needed.

2. Habitat Preferences

Estimating stocking rates in tributaries and determining the location of acclimation sites within those tributaries will be supported by habitat evaluations. Smolt carrying capacity estimates, which included an Ecosystem Diagnosis and Treatment analysis, are the basis for the smolt release numbers in Table 1.

Identifying the specific location of spawning and rearing habitat within the watersheds is a more complex task. Spawning habitat may be in different areas than rearing habitat and the relationship between them can impact program design. The objective of the MCCRP is to encourage adults to return to spawning areas that have associated quality rearing habitat.

Coastal coho rearing preferences have been evaluated in several studies. Hilborn et al. (2001) found that pool and pond densities, low valley slopes, low road densities, and low stream gradients were correlated with high coho smolt densities in western Washington. Rosenfeld (2000) concluded that the best predictor of coho abundance in British Columbia watersheds in the June-September time period was stream width (the highest densities occurring in widths under 5 meters).

Puget Sound (WDFW coho biologist Jeff Haymes, personal communication) and review of SalmonScape, the WDFW habitat mapping program) and Thompson River (Mike Bradford, Fisheries and Oceans Canada, personal communication) coho demonstrate a spawning preference for low gradient, low flow streams that have rearing habitat a short distance downstream. During years when these streams are not accessible, spawning occurs in larger bodies of water. Although significant large stream spawning occurs, reintroduced Columbia basin coho are being attracted to low flow, low gradient streams as well. Examples include Marion Drain, Ahtanum Creek, Nelson Springs, Sulphur Drain in the Yakima and small tributaries between Wanapum and Rock Island dams for Wenatchee released coho. Low flow streams will not support large numbers of fingerlings or pre-smolts and migrations to separate rearing habitat are necessary. Imprinting during these fresh water movements (Dittman et al., 1996) allows natural coho to return to spawning areas, despite beginning seaward migration as pre-smolts from rearing habitat. Since returns to specific spawning habitat are a goal, releases directly from those areas could replace fry migration imprinting with smolt migration imprinting.

Much of the literature on coho habitat preferences is written for coastal, rain dominated watersheds. The mid-Columbia has snow dominated watersheds with hydrograph peaks during spring run-off. Interior Fraser coho stocks face similar flow conditions and migration distances and these stocks originated from the Columbia River (Smith et al., 2001). They show a preference for spawning in the upper reaches of the low gradient sections of watersheds. For example, spawning ground counts show the highest abundance in the upper reaches of the Coldwater River (Nelson et al., 2001 and Nicola Tribal Association, personal communication) and the most productive stream in the Fraser system is the Eagle River above Three Valley (Richard Bailey, program head Stock Assessment/Resource Management, BC Interior Area, DFO personal communication). Interior Fraser stocks show a preference for areas that are similar to those in the Chiwawa, White, Chewuch, Twisp and upper Methow rivers.

There are other aspects of interior B.C. coho spawning behavior that can be applied to MCCRP program design. Interior B.C. coho stocks show a high degree of adaptability and plasticity in spawning habitat selection. When the small streams that are preferred habitat are not accessible due to low flow conditions or beaver dam construction, spawning can occur in nearby areas of larger tributaries. Spawning occurs in about 1 out of 3 or 4 years in the North Thompson when normally productive, small tributaries like Lion Creek and Mud Creek are not accessible. Spawning preferences may also be highly influenced by the presence of groundwater in both the smaller and larger tributaries (Richard Bailey, personal communication).

A common theme with both spawning and rearing habitat evaluations in coastal and interior populations is coho preference for low gradient stream environments. A first order approximation of habitat location has been made based on stream slope. Figures 8 and 9 are maps that show the low gradient (less than .5% and 2%) stream sections in the Wenatchee and Methow watersheds. Acclimation sites are situated using them as a general guideline.

C. ACCESS

Transport of pre-smolts to acclimation sites requires road access. Due to their weight, size, and the value of the coho cargo; fish transport trucks are restricted to plowed roads. Daily feeding and screen cleaning are activities that require access. During storm events, debris may need to be removed from water intake screens at a high frequency. These factors limit the location of acclimation sites to those that have nearby accessible roads.

D. COST

Both capital and operating costs are important evaluation considerations. In this appendix, average values of costs to construct and operate acclimation facilities in the region are used to compare different systems (Appendices C.3 and C.4 estimate site specific costs for the proposed acclimation system alternative). The details of the cost estimating procedures used are listed in Attachment 1, CAPTIAL AND OPERATING COST BASIS. Other program components; brood capture, rearing, and monitoring and evaluation, are not included in these operating and construction cost estimates.

E. ENVIRONMENTAL IMPACTS

Environmental factors play an important role in selecting sites and acclimation methods. Facility construction that limits access to and from streams with habitat used by other species is one of these factors. Some water intake structures and coho migration barrier designs prevent adult and fry migrations. The primary species of concern in the small tributaries of the region are bull trout and steelhead. Impacts to both their movement and use of habitat will be evaluated during NEPA, ESA and site permitting processes and were considered during the conceptual site selection and design phase. Acclimation site locations away from important migration paths with designs that do not impede natural passage will be used to minimize these impacts.

The effect of fish waste on downstream water quality and on the acclimation pond environment is another major design consideration. Current National Pollution Discharge Elimination System (NPDES) policy allows the administering agency, Washington Department of Ecology (WDOE), to waive the requirement for a discharge permit if production gains at a specific site are less than 20,000 pounds per year or food fed is less than 5,000 lbs per month and if impacts are considered minor. Most acclimation sites in the proposed plan will be under this limit. 5,000 pounds will feed approximately 200,000 coho smolts per month. However, WDOE is now evaluating the cumulative impact of multiple acclimation sites. Permits may be required in the future, which at the minimum would involve water quality monitoring. It is also possible that waste treatment procedures may have to be implemented.

Ponds and the constructed habitats that are built for the program are intended to be positive environmental features. Acclimation ponds will be naturally populated by various plant and animal species. Anadramous fish species in particular will benefit from the addition of more rearing habitat.

F. FLEXIBILITY

Future changes in adult dispersal patterns and spawning habitat preferences as local adaptation proceeds and changes in the numbers of fish to be released in each tributary will influence acclimation site selection. Acclimation facilities will need to be able to adapt to these changes. The ability to change site locations and sizes cost effectively is important features of an acclimation plan.

G. OTHER

Trucking impacts are discussed in Appendix A, CULTURING GUIDELINES. In general, trucking distances are not critical since most stress is induced during loading operations. However, disease transfer considerations may place limits on trucking between major watersheds.

Many acclimation sites are in the upstream areas of watersheds. Operating facilities in these areas will be difficult. Snow will affect access and stream icing conditions will impact water availability. Multiple remote sites make emergency response more complex and add to risk.

Other siting criteria for acclimation facilities are similar to those discussed for rearing facilities in Appendix B.1. Water use impacts, ESA issues, wetlands, construction permits, environmental impacts, land availability, expansion capability, utilities, and road access are all siting considerations.

IV. *ACCLIMATION ALTERNATIVES*

The various options for acclimation and release systems are described and compared in the following two sections, A and B. The last chapter, C, lists the specific sites that can be used in the systems that best meet program objectives. Chapter V describes the proposed acclimation plan alternative.

A. ALTERNATIVE SYSTEM DESCRIPTIONS

1. Number of Sites

The following discussion of the number of sites uses these definitions:

Watersheds: Wenatchee, Methow

Tributaries:

- Wenatchee Basin: White River, Peshastin Creek, Icicle Creek, Beaver Creek, Chiwawa River, Little Wenatchee River, Icicle Creek
- Methow Basin: Chewuch, Twisp, Wolf Creek, Upper and Mid Mainstem, Gold Creek, Beaver Creek

a. No acclimation sites used

Truck planting adults, fry, and/or smolts are alternatives to acclimation. Adult plant based restoration has shown some promise in helping with steelhead recovery efforts in Hood Canal (Berejikian et al., in press). Direct plants allow the widespread distribution of coho to all areas with road access. Acclimation facility costs are eliminated and the flexibility to change release locations and numbers is maximized as well. However, adult and fry plants result in high early life history mortality. Direct smolt plants in the Yakima River failed to generate widespread naturally reproducing populations, as previously described. Adult stray rates are lower for acclimated smolts (Johnson et al., 1990 and Labelle, 1992) and the impact of trucking on fully smolted fish can be severe. As a result, direct plants will be used only in isolated circumstances, seeding areas with poor access or where acclimation sites cannot be built.

b. One per Watershed

If adult dispersal patterns remain very broad and centered below the point of release, a single, large acclimation site in an upstream area may seed an entire watershed. With wide distribution and high survivals, adults would enter all tributaries and find appropriate spawning habitat. During the natural production implementation phase, such a site in the Methow and Wenatchee would acclimate and release 1,000,000 smolts each.

Due to economies of scale and the reduced cost of operating single sites, this system option has the lowest operating costs of all the alternatives that use acclimation. Reliability would be high due to the water supply redundancies that could be built into a large facility and long-term acclimation would be possible.

However, if the current dispersal patterns continue the rapid changes associated with local adaptation, this system may not adequately seed adults into all tributaries. As the population becomes more capable of returning to release origins, distant tributaries may be bypassed. Also, the impact of catastrophic losses (from disease outbreaks or facility failures) at single sites would be severe, the capital cost of building a large acclimation site is high, and the environmental impact of the large water withdrawal required of such a site would be significant. Mega-sites will have limited flexibility. Changes in release locations would not be feasible as the program evolves.

c. One per Tributary

A system that moderates some of the limitations of the mega-site is a system where smaller facilities are used on each tributary. Returning adults would be expected to disperse and find correct spawning habitat only in that tributary.

Catastrophic fish loss impacts would be reduced by having multiple release locations; however, the risk of losing individual site production is higher due to the need to depend on lower cost water supply systems. Long-term acclimation may not be possible at some of the sites due to water supply stability and winter access issues.

The long-term plan identifies 6 tributaries in the Wenatchee Subbasin and 4 tributaries in the Methow Subbasin for proposed coho releases. With this alternative, each tributary would have a single acclimation site.

d. Multiple per Tributary

Multiple sites per tributary reduce release numbers per site, increasing the opportunity to use existing natural small ponds and side channels. Natural sites are predicted to produce smolts with wild characteristics that survive at high rates.

Predator control is more difficult with multiple sites, especially in natural ponds where fencing and netting may not possible. Predator control would be manpower dependant, using methods currently employed by the project at upstream Wenatchee watershed acclimation sites.

With a heavy emphasis on existing ponds, the capital cost of this system will not be large. However, the cost of operating many sites in remote locations would be high.

2. Location Options

a. Downstream of Habitat

Traditional hatchery practices release smolts directly from hatcheries, which are frequently located downstream or in the lower reaches of natural habitat. Adults not needed for spawning can be returned to the river and some may continue moving upstream above the hatchery. Coho acclimation sites could operate on a similar principal if returning stocks were motivated and capable of moving past release locations. However, releases well downstream of habitat may encourage spawning in marginal areas and is unlikely to result in sufficient dispersal of returning adults.

Acclimation facilities in downstream areas are relatively easy to construct and operate. There is generally private land available and project environmental impacts are minimized when previously disturbed land is developed. Multiple water supply options would be available due to the wider area that would be suitable for siting.

b. Upstream of Habitat

Imprinted releases in areas upstream of habitat may allow returning adults to distribute into more suitable areas as they move toward acclimation sites. This is behavior that MCCRP adults are, to a degree, exhibiting now.

Pumped water facilities, seasonal stream water supplies, and use of mainstem tributary water may also encourage wide dispersal. If imprinting water is not being discharged from the acclimation facility in the fall when adults are returning, they may be less focused on a specific area.

Releasing upstream of spawning and rearing habitat may also result in some spawning in less favored areas. Streams feeding tributaries may not be fully populated if acclimation occurs some distance above them.

Construction and operation of facilities in upstream areas will be more difficult than in downstream areas. Winter access, water supply, and permitting considerations may make sites in these areas expensive and will add elements of risk. In areas without plowed roads, acclimation sites may be accessible for limited times during the late winter and spring. A flexible program that allows fish to be transported based on year-to-year road conditions may be required.

c. In Spawning Habitat

If natural mid-Columbia River coho stock behavior becomes similar to coastal stocks, acclimation sites on small streams may be effective. This would be encouraged by releasing smolts directly into spawning habitat in several locations in each tributary. After establishing successfully reproducing

populations in those streams, straying from them may colonize other appropriate areas in the tributary (Nickelson et al. 1998).

Water flows in small streams will limit the number of smolts that can be acclimated. This system would require multiple sites to be developed and operated. Steep valley walls that are close distances to tributary channels are typical of many Mid-Columbia areas. These conditions limit the quantity of low gradient, small stream spawning habitat available as potential acclimation sites.

3. Water Supply Options

There are several options for supplying water to constructed acclimation ponds. A preferred system is the in-line option in which an entire creek flows through a pond. The in-line option eliminates the need for an intake structure and provides a high degree of reliability. The disadvantage to the in-line option is that barrier nets would block upstream and downstream fish passage during the acclimation period.

Surface water can be diverted to rearing units. For remote sites, maintaining intakes during storm events may be difficult and pumped ground water systems with back-up generators may be required.

The constant temperature of ground water may negatively affect smolting (see Appendix A). However, ground water during the spring acclimation period will be warmer than winter surface water. The change from rearing in cold water to acclimating on warm ground water will mimic natural conditions and reduce negative impacts. An advantage of ground water is that warmer temperatures allow long-term (over-winter) acclimation. Operation through the winter will be significantly easier with spring or pumped well water than with surface water that is subject to icing, low flows, and heavy flood debris loads.

4. Design Options

a. Existing Ponds

Many beaver ponds, side channels, and man-made ponds exist throughout the Mid-Columbia region. Existing ponds in appropriate locations and that have adequate water flow is suitable for coho acclimation. An example of an existing beaver pond that has been successfully used for acclimation is on Coulter Creek (Figure 2).

Figure 2. Coulter Acclimation Site

The highly natural conditions of many existing sites are expected to improve adult return rates. Low density rearing, some natural feed, mature vegetation cover, and hydraulic diversity are conditions that may enhance smolt quality. Many of the identified ponds have the advantage of in-line water supplies as well, although they will be difficult to operate through the winter.

Feeding and predator control may be complicated by large pond sizes and thick vegetation at some sites. Existing natural sites do not have fish waste removal capability, possibly limiting use for acclimation. Also, these sites typically require blocking access by other species to and from the ponds during the acclimation period. ESA consultations would be needed to address these impacts..

b. Constructed Pools

Simple earthen ponds can be constructed at many locations. The preferred method is to excavate a pond in a creek channel. Barrier nets would be used to block pond exits during acclimation; no permanent structures are needed.

Advantages of constructed pools include low cost construction, a wide range of siting alternatives, fish culture friendly design, and high water supply reliability. Constructed pools may also be a positive habitat feature as they are populated by other species when not used for coho acclimation. However, permitting may be difficult in undisturbed areas and where ESA listed species are present. An example of a constructed natural pond with an in-line water supply is the Rohlfing pond on Nason Creek (Figure 3).

Figure 3. Rohlfing Acclimation Site

c. Constructed Acclimation Facilities

Several acclimation facilities (Chewuch, Twisp, Chiwawa, Dryden, and Carlton) currently exist in the Wenatchee and Methow basins. Constructed Acclimation Facilities have lined bottoms, predator net systems, water inlet and outlet structures, and are fenced (Figure 4). Both gravity flow water from irrigation canals and pump stations are used for water supplies.

Constructed Acclimation Sites have the advantages of full predator control and managed waste removal. Facilities with pumped water supplies can be built in a variety of areas and can be located based on biological criteria and land ownership. If ground water is available, they would be capable of winter operation.

Figure 4. Carleton Acclimation Site

d. Constructed Natural Habitats

Constructed natural rearing habitat is discussed in Appendix B.1 as a combined rearing and acclimation strategy. Constructed habitat consists of engineered pools, runs, riffles, alcoves, and ponds (Smith et al., 2004). Additional features include woody debris and overhead cover. Controlled water flow can be supplied by existing springs, by gravity flow intakes on surface streams, or by pumped wells. Tagged fingerlings are planted in the habitat and reared to sizes up to full smolt. The main benefit of constructed habitat is the production of smolts with close to wild characteristics. This type of system is expected to maximize adult return rates.

The large amount of land needed is a significant disadvantage to constructed habitat as an acclimation system. Expanding preliminary production rates to a full 2,000,000 smolt program results in an estimated land requirement of approximately 90 acres of constructed habitat (density of 0.5 smolt per square ft, Dave Smith, S.P. Cramer, personal communication) scattered throughout the Mid-Columbia region. Although construction is relatively simple and there is a cost advantage to combining rearing and acclimation at one site, costs are high due to this large land requirement.

At some sites it may be possible to construct spawning habitat into the habitat design. Spawning habitat may be useful in locations where natural production is spawning habitat limited.

e. Concrete Raceways

Acclimation rearing units constructed with concrete have the advantage of allowing exact replicates to be built to support studies. The Yakima spring chinook supplementation project uses raceways for this purpose (Figure 5).

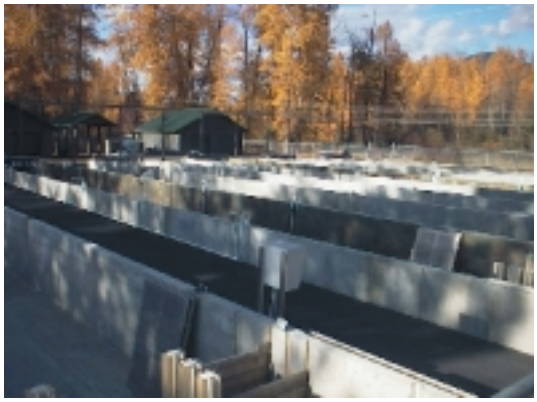

Figure 5. Easton Spring Chinook Acclimation Facility

Predator control, fish waste handling, and feeding systems are very functional at this type of facility. However, rearing in concrete raceways may produce smolts with relatively low adult survival rates (see Appendix A). The cost of construction, lack of adaptability to changing program needs, and potential environmental impacts are other drawbacks.

B. ALTERNATIVE SYSTEM COMPARISONS

1. Comparison Summary

The acclimation options are compared using the evaluation criteria developed in Chapter III. In general, it is expected that adult return rates will be highest from systems that have long (over-winter) acclimation periods, use surface water, and have a natural design. Costs will be lowest for alternatives that are based on existing ponds and constructed pools with gravity flow water supplies (see the next section and Attachment 1 for more detail on costs). The matrix below summarizes the evaluation of acclimation system alternatives and is used to develop the recommended acclimation plan described in Chapter V.

Table 2. Comparison of Acclimation System Options

	NUMBER OF SITES				LENGTH OF ACCLIMATION			LOCATION			WATER SUPPLY				DESIGN				
Criteria	None	One per Watershed	One per Tributary	Multiple per Tributary	None	6 Weeks	6 Months	Below Habitat	Above Habitat	In Spawning Habitat	Surface Gravity	Surface Diverted	Surface Pumped	Ground	Existing Ponds	Constructed Pools	Constructed Acc. Facilities	Constructed Habitat	Concrete Raceways
Adult Return Rates	P	G	G	G	P	G	G	G	G	G	G	G	G	P	F	F	F	G	P
Returns to Habitat	P	P	G	G	P	F	G	P	G	G									
Returns to Spawn. Habitat	P	P	F	G	P	F	G	P	F	G									
Capital Cost	G	P	F	G	G	F	P	G	F	F	G	F	P	P	G	G	F	F	P
Operating Cost	G	G	F	P	G	F	P				G	F	P	P					
Winter Operation	G	G	F	P	G	F	P	G	P	P	F	P	P	G					
Environmental	G	G	F	P	G	F	P	G	F	F	P	F	F	G	G	G	F	F	P
Program Flexibility	G	P	F	G	G	F	F								G	G	F	P	P

Key: G = Good, F = Fair, P = Poor

In evaluating the various acclimation alternatives, certain options and combinations of options will not be considered for use as the basic system in the proposed plan for reasons summarized below. The above sections give more detail on the rationale for excluding these options, the master plan details program goals and Attachment 1 includes cost information referenced below. The low priority options and combinations are:

- The no-acclimation option will not produce the numbers of returning adults needed to meet program goals.
- The one-site per watershed is unlikely to disperse adults into habitat at a rate that will meet program goals.
- The constructed concrete raceway option has a high capital cost.
- The combination of one release site per tributary and existing ponds is not realistic in the major tributaries. The capacity of the existing ponds is not large enough to acclimate the planned numbers.
- The combinations of pumped waters supplies and/or constructed acclimation facilities along with multiple sites per watershed will have a capital cost that is too high.
- Releasing all program fish from constructed habitats will have a high capital cost and is a technique that has not yet been fully evaluated.

2. System Cost Evaluation

The cost of constructing and operating several remaining program option combinations can be compared as part of the evaluation process. These alternatives are general designs developed for analysis purposes only. They are all, however, practical alternatives.

- *Alternative 1. Multiple release sites consisting of existing, gravity fed ponds*. There are 6 different tributaries in the Wenatchee and 5 in the Methow that are targeted for releases (for the purposes of this comparison, the upper and mainstem Methow is divided into two release groups). The total number of release areas is then 11. This alternative uses existing ponds which are generally small. It will be assumed that an average of 3 will be needed per release area for a total of 33 release locations.
- *Alternative 2. Multiple release sites consisting of small, gravity fed, constructed pools.* These pools can be larger than the existing ponds, an average of 2 per tributary is assumed for a total of 22.
- *Alternative 3. One release site per tributary from constructed habitat facilities using pumped water*. Each of the 11 main release areas would have one of these facilities constructed on it.

The estimated capital and acclimation (only) operating costs for these alternatives are shown in the table below. The estimating methods are described in Attachment 1. The capital costs were based on recent construction projects in the region and the operating costs are based on the current MCCRP budget. The present value of the operating costs was calculated assuming a 20 year life and a 3% annual interest rate (the long-term historical average).

Table 3. Cost Comparison of Acclimation Options

	Capital Cost	Annual Operating Cost	Total Present Value of Operating Cost	**TOTAL PRESENT VALUE**
Alternative 1	$330,000	$450,478	$6,700,000	**$7,030,000**
Alternative 2	$6,270,000	$356,932	$5,300,000	**$11,570,000**
Alternative 3	$16,126,000	$263,387	$3,900,000	**$20,026,000**

The table demonstrates that Alternatives 1 and 2 have lower lifetime costs than Alternative 3. This is mainly the result of the high capital cost of constructing water supply systems and structured rearing systems. Specific acclimation sites, where possible, have been selected that can be used in alternative systems 1 and 2.

C. IDENTIFIED SITES

Figures 6 and 7 show the location of sites that are currently identified as potential acclimation sites. Sites have been selected that have the water flow and rearing space available for holding more than 50,000 smolts (a minimum spring time flow of 1 cfs and at least 30,000 cft of rearing volume) and that best meet the siting and design guidelines.

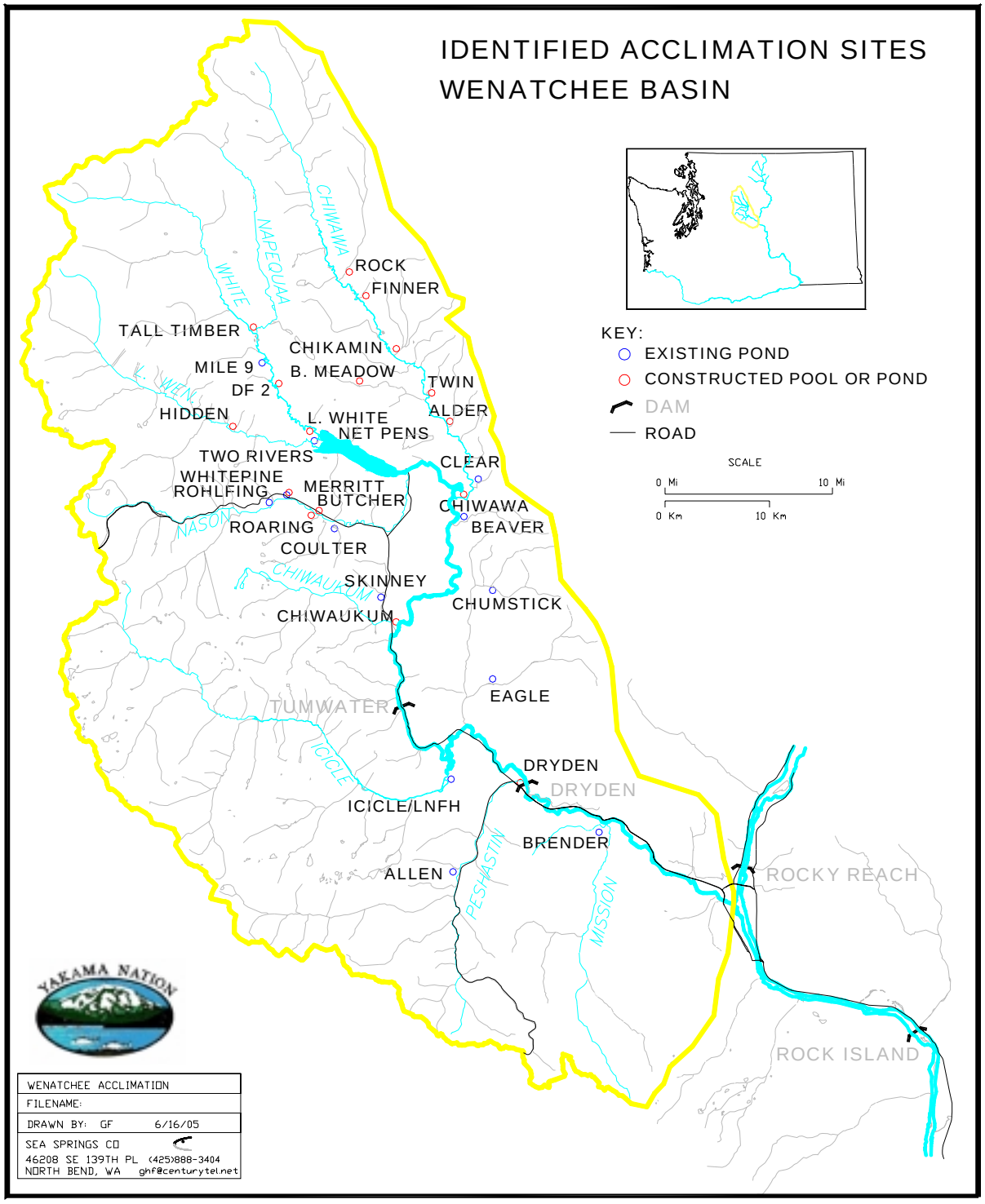

Figure 6. Identified Acclimation Site Map, Wenatchee

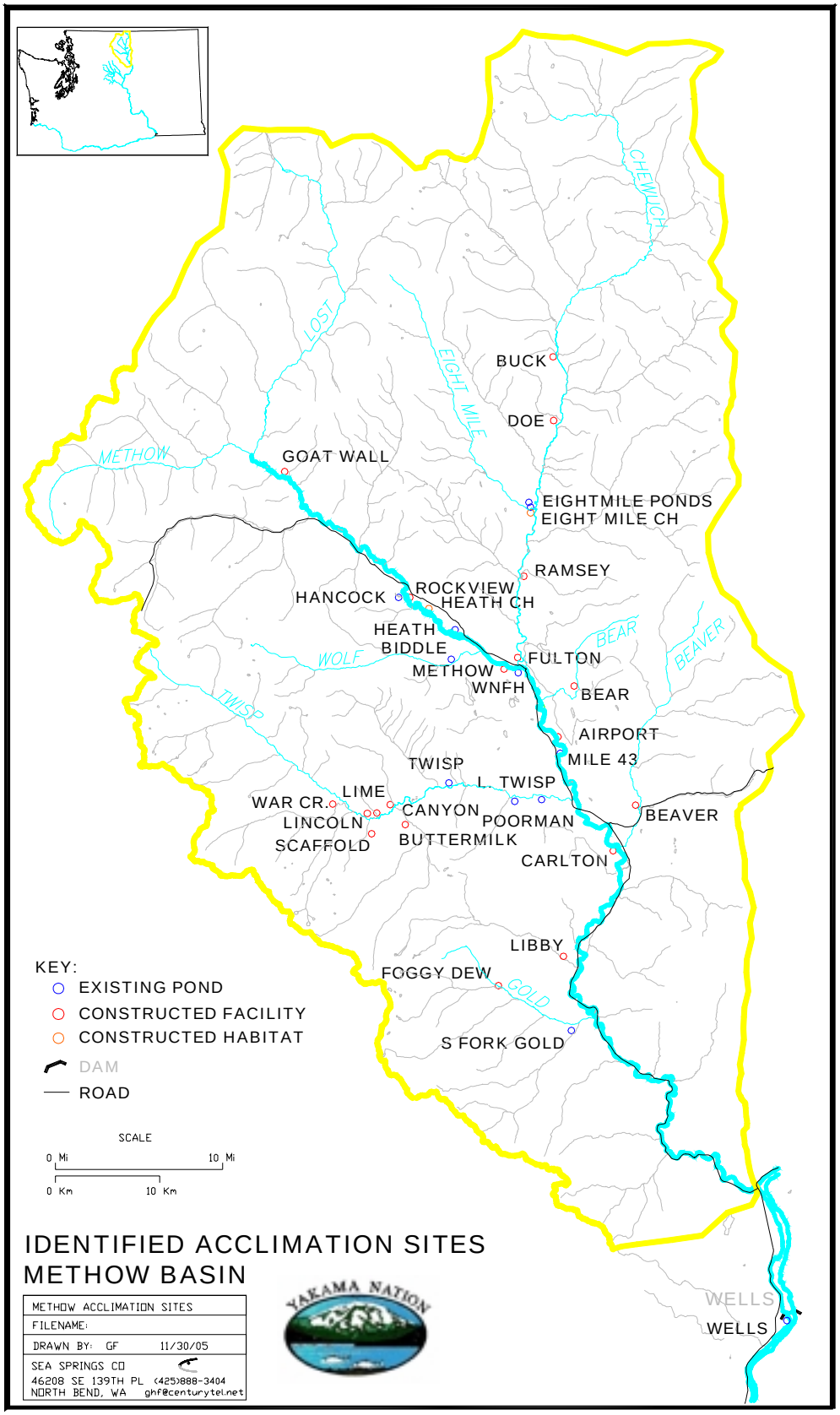

Figure 7. Identified Acclimation Site Map, Methow

The tables below present information on the identified sites (Table 4 and 5).

1. Existing

Table 4. Identified Existing Sites - Characteristics

SITE	BEAVER POND	MANMADE POND	NATURAL CHANNEL	GRAVITY, GROUND	GRAVITY, SURFACE	DIVERSION	PUMPED, GROUND	PUMPED SURFACE	BULL T, SH, SP CHNK	NO FISH IMPACTS	BROOD DEVELOPMENT	WINTER USE	OWNERSHIP	TRIB	NOTES
WENATCHEE	Site Count =				15										
Brender		X			X					X		X	PR	Mission	15,000 cft pond
Icicle						X	X	X		X	X	X	PU	Icicle	Hatchery raceways or Dam 5, brood development purpose
Chumstick		X			X					X			PR	Chumstick	Pond formed by dam
Eagle			X		X					X			PR	Chumstick	
Allen		X			X	X				X			PR	Peshastin	Community pond
Skinney	X				X				X				PR	Chewaukum	
Beaver		X			X				X				PR	Nason	75,000 coho released per year, in use since 2002
Butcher	X				X					X			PR	Nason	100-150,000 coho released per year, in use since 2000
Coulter	X				X				X				PR	Nason	80-110,000 coho released per year, in use since 2003
Whitepine	X			X					X			X	PU	Nason	Spring fed creeks, site near campground, ponds shallow
Rohlfing		X			X		X		X			X	PR	Nason	36,000 cft pond, limited fall flow, well on site
Clear		X		X					X			X	PR	Chiwawa	Ponds on existing private campground
Mile 9	X				X				X				PU	White	Access from west side of river in winter limited
LW Net Pens		X			X					X		X	PU		Purpose would be wide distribution in the Wenatchee system
Two Rivers		X					X	X		X		X	PU	L. Wen.	100,000 smolts in 2003 and 04. Water pumped from mine lake
METHOW	Site Count =				16										
Wells		X				X	X	X		X	X	X	PU	Columbia	Purpose is broodstock development and back-up
S Fork Gold		X			X				X				PR	Gold	
Lower Twisp		X			X		X		X			X	PR	Twisp	Water is diverted from the Twisp and wells exist as back-up.
Poorman		X		X						X		X	PR	Twisp	
Twisp Acc Site	X				X	X				X			PR	Twisp	Pond downstream of existing facility, water could be added from canal
Lincoln		X			X			X					PR	Twisp	Two ponds that natrually flow during high water
War Ponds	X				X				X				PU	Twisp	Large beaver pond complex
Mile 43			X		X				X				PR	Methow	Limited flow
Winthrop NFH		X				X	X	X		X	X	X	PU	Methow	This is currently an active rearing and release site
Biddle		X			X	X				X			PR	Wolf	
Heath	X			X					X			X	PR	Methow	Value of existing habitat may require new pond construction
Big Valley	X			X		X			X			X	PR	Methow	Value of existing habitat may require new pond construction
Hancock			X	X					X			X	PR	Methow	Recent rehabilitation project improves conditions for coho
Ramsey		X			X				X				PR	Chewuck	Large private pond
Sherwood	X				X				X				PU	Eightmile	
Eightmile		X			X	X				X			PR	Chewuck	Used in the past for coho acclimation

2. New

Table 4. Identified New Sites - Characteristic

SITE	POOL	ACCLIMATION FACILITY	CONSTRUCTED HABITAT	GRAVITY, GROUND	GRAVITY, SURFACE	DIVERSION	PUMPED, GROUND	PUMPED SURFACE	BULL T, SH, SP CHNK	NO FISH IMPACTS	LOCAL SPAWNING	BROOD DEVELOPMENT	WIDE DISTRIBUTION	WINTER USE	OWNERSHIP	TRIBUTARY	NOTES
WENATCHEE	Site Count =				17												
Dryden		X					X	X		X			X	X	PR	Wenatchee	Hatchery site at the mouth. Pumped shallow ground and Wenatchee water
Chiwaukum		X			X	X			X		X			X	PU	Chiwaukum	Near the mouth of Chiwaukum adjacent to Tumwater Campground
Butcher			X		X				X				X		PR	Nason	Less than 4 acres of land, pumped groundwater and gravity flow surface
Roaring	X				X				X		X				PR	Nason	Good spawning habitat in creed, good rearing habitat in pond complex below
Merritt		X					X	X		X			X	X	PR	Nason	Pumped shallow ground and Nason water
Whitepine	X			X					X				X	X	PU	Nason	Nason Ridge springs, site near the Whitepine campground.
Hidden	X				X				X		X		X		PU	L. Wenatchee	Could be above Bull trout and Steelhead habitat, road closed in winter
Lower White		X					X	X		X			X	X	PR	White	Pumped ground and White water
DF 2			X		X				X		X				PR	White	Good potential spawning habitat in creek
Tall Timber		X						X		X			X	X	PR	White	Pumped White and possible ground water
Chiwawa		X						X		X			X	X	PU	Chiwawa	Potential hatchery site that could also release fish
Alder	X				X				X		X		X		PU	Chiwawa	Road closed in winter, snowmobile use. Bull t., SH presence may require intake
Twin	X				X				X		X		X		PU	Chiwawa	Road closed in winter, snowmobile use. Bull t., SH presence may require intake
Big Meadow	X				X				X		X		X		PU	Chiwawa	Road closed in winter, snowmobile use. Bull t., SH presence may require intake
Chikamin	X				X				X		X		X		PU	Chiwawa	Road closed in winter, snowmobile use. Bull t., SH presence may require intake
Finner	X				X				X		X		X		PU	Chiwawa	Road closed in winter, snowmobile use. Bull t., SH presence may require intake
Rock	X				X				X		X		X		PU	Chiwawa	Road closed in winter, snowmobile use. Bull t., SH presence may require intake
METHOW	Site Count =				17												
Foggy Dew	X				X				X		X				PU	Gold	Site near mouth at campground
Libby	X				X				X		X				PR	Gold	
Carleton		X					X	X		X			X	X	PR	Methow	Site near acclimation facility could use existing intake and new wells
Buttermilk	X				X				X		X		X		PR	Twisp	Bull t., SH presence may require intake
Canyon	X				X					X	X		X		PR	Twisp	Could be above Bull trout and Steelhead habitat
Lime	X				X					X	X		X		PR	Twisp	Could be above Bull trout and Steelhead habitat, very small creek
Scaffold	X		X		X				X		X		X		PU	Twisp	Could be above Bull trout and Steelhead habitat, access on south bank difficult
War Cr	X				X				X		X		X		PU	Twisp	Could be above Bull trout and Steelhead habitat, access on south bank difficult
Airport	X				X	X				X			X	X	PR	Methow	Irrigation intake return flow
Bear	X				X				X		X				PR	Bear	Bull t., SH presence may require intake
Methow FH		X		X	X					X		X		X	PU	Methow	Pond using hatchery discharge water
Rockview	X				X				X		X		X	X	PU	Methow	Bull t., SH presence requires new pond construction, irrigation return flow
Goat Wall	X			X					X		X		X	X	PR	Methow	Spring, upstream of dry section of Methow
Fulton	X				X	X				X			X		PR	Chewuck	Irrigation ditch on lower Chewuch
Eightmile			X		X				X		X		X	X	PU	Chewuck	Constructed habitat site near mouth, existing wells may allow winter use
Doe	X				X				X		X		X		PU	Chewuck	Road closed in winter, snowmobile use. Bull t., SH presence may require intake
Buck	X				X				X		X		X		PU	Chewuck	Road closed in winter, snowmobile use. Bull t., SH presence may require intake

V. *RECOMMENDATIONS*

A. PROPOSED ALTERNATIVE

Details about the site locations, designs, and costs of the proposed acclimation plan are included in Appendices C.3 and C.4. This chapter discusses the general program configuration and summarizes the selection rationale.

The comparison summary and cost tables in Chapter IV.B show that the acclimation systems that will produce the highest adult return rates at the lowest cost with the most program flexibility are those that use existing ponds and constructed pools and have gravity flow water supplies. This acclimation system reduces water requirements, reduces risks due to single site losses, reduces environmental impacts, releases fish into a variety of habitats, and completes rearing in highly natural environmental conditions.

The rearing system proposed (see Appendix B.1) makes extensive use of existing hatchery capacity. Fish produced and released directly from these systems would be expected to have relatively low return rates (see Appendix A). However, the effect of this hatchery rearing environment can be mitigated by acclimation. Long-term acclimation, through the second winter and spring, is therefore emphasized in the proposed acclimation plan.

Selection of most release locations assume that adults will disperse widely around the point of release. General consensus is that coho will find appropriate spawning habitat, irrespective of specific imprinting clues. Many release locations are near high quality rearing habitat and some are located directly in spawning habitat.

Practical considerations that are the result of specific conditions in the watersheds and tributaries suggest that acclimation systems other than existing ponds and constructed pools be developed in some cases. These sites are described in the following sections.

A total of 18 release locations are proposed in the Wenatchee and Methow watersheds. Eleven of these sites exist now and do not require significant amounts of construction (6 of these 11 are currently being used by the MCCRP). Of the remaining 7 locations that do require construction, 2 will be used for rearing as well as acclimation/release. Following is a summary of features of the recommended system:

- Multiple sites in most of the large tributaries.
- Gravity flow, surface water supplies at most sites.
- Existing ponds and constructed pools at most sites.
- Combined acclimation/rearing at select locations.

The overall shape of ponds at sites that require new construction will be semicircular. This shape will allow the distribution of feed to all fish from one location on the interior shoreline (see the drawings in Appendices C3 and C4), minimizing the conditioning of fish to associate food with large moving bipeds objects. The shorelines of the ponds will be irregular, forming alcoves and peninsulas. This will add hydraulic and general environmental complexity. Trees planted around the perimeter will add shade and along with the pond shape will reduce bird landing areas.

1. Wenatchee

The proposed alternative for the Wenatchee Natural Production Implementation Phase includes releases at 9 different locations. Six of the locations are existing sites; one is a new, conventional acclimation facility on the upper White River; one is a new pond adjacent to the existing Chiwawa Acclimation Facility; and one is a constructed pond on Chikamin Creek, a tributary of the Chiwawa River. Over half of the releases will be from acclimation sites capable of overwinter acclimation.

Large releases relative to habitat capacity are proposed for Icicle Creek. The Icicle Creek release has a dual purpose; to develop a naturally spawning population and to serve as a back-up source for local broodstock.

The proposed Chiwawa sites are important parts of the Wenatchee program, with 40% of the planned releases for the entire Wenatchee basin. However, roads to the high quality habitat areas are closed in winter. As a result, releases in the lower section of the river, at the Chiwawa Acclimation Facility

and Clear Creek, are proposed. One upstream acclimation location, Chikamin, would be accessed with snowmobiles or after the snow clears in spring.

The Little Wenatchee River site also has winter access problems. Acclimation is proposed in the more accessible lower part of the habitat.

Habitat analysis and capacity estimates indicate that the White has significant amounts of coho habitat. Winter access to most of that habitat is good. The road is plowed up to Tall Timber Ranch (RM 10). There are a limited number of small tributaries and no existing ponds that are accessible. Therefore, a conventional, standard acclimation facility with a pumped water supply is proposed on the White.

Nason Creek has an existing site at the upper end of the low slope section that is capable of winter operation. The purpose of the Rohlfing site, which is currently being used by this project, will be to disperse adults into downstream areas. The Coulter/Roaring site that is also existing and being used is further downstream and discharges into a large beaver pond complex that is expected to be productive rearing habitat.

Table 5. Wenatchee Acclimation Proposed Alternative, NPIP

Stream Location / *Site*	*Total for Stream* / *Type of Site*	*Water Supply (G = Gravity, P = Pumped)*	*Overwinter Acclimation*	*Short-term Acclimation*
Icicle	*75,000*			
Icicle	Existing	P ground & P surface	75,000	
Nason	*210,000*			
Rohlfing	Existing pond	P ground & G surface	105,000	
Coulter/Roaring	Existing pond	G surface		105,000
White	*210,000*			
Tall Timber	Constructed facility	P ground & P surface	210,000	
Upper Wenatchee	*100,000*			
Beaver	Existing pond	G surface		100,000
Chiwawa	*440,000*			
Clear Creek	Existing pond	G spring	170,000	
Chiwawa	Constructed pool	G surface	170,000	
Chikamin	Constructed pool	G surface		100,000
Little Wenatchee	*120,000*			
Two Rivers	Existing pond	P ground & P surface		120,000
TOTALS	**1,155,000**		**730,000**	**425,000**

2. Methow

A total of 9 release locations are proposed for the Methow watershed. Five of the release locations are existing ponds, two are constructed habitat projects, one is a new, pumped water site on the upper Methow River, and one is a site that requires a new pumped water supply. Over half of the releases are from sites that are capable of overwinter acclimation.

During the winter, the Chewuch River Road is plowed up to Eightmile Creek, which is in the upper half of the low slope reach. Releases at Eightmile are proposed as a result, from one of the constructed habitat projects.

The Twisp River has good road access and some existing ponds in potential habitat areas. The Lincoln site has existing ponds but water must be pumped to them. The location in the upstream part of the low gradient section of the Twisp and the plowed access road make it a valuable release location. Poorman is downstream of most of the low gradient section but has existing ponds as well.

The upper and mid mainstem Methow presents some unique challenges and opportunities. The river above Weeman Bridge to the mouth of the Lost River goes dry periodically. However, coho will be able to access the area after fall rains improve passage. The Goat Wall release site is proposed to encourage seeding of this area. Below Weeman Bridge, surface recharge creates several large springs. Hancock Springs and springs on Heath and Big Valley ranches create important spawning and rearing habitat. Constructed habitat and long-term acclimation sites are planned for this area.

The Winthrop NFH is both a rearing and release facility. Winthrop NFH is near habitat areas and will be an important contributor to both brood collection and habitat seeding objectives.

Table 6. Methow Acclimation Proposed Alternative, NPIP

Stream Location / *Site*	*Total for Stream* / *Type of Site*	*Water Supply (G = Gravity, P = Pumped)*	*Overwinter Acclimation*	*Short-term Acclimation*
Chewuch	*325,000*			
Eight Mile	Constructed habitat	P ground & G surface	200,000	
Ramsey	Existing pond	G surface		125,000
Twisp	*275,000*			
Poorman	Existing pond	G spring		137,500
Lincoln	Existing pond	P surface	137,500	
Wolf Creek	*50,000*			
Biddle	Existing pond	G surface		50,000
Upper and Mid Main.	*350,000*			
WNFH	Existing pond	G surface & P ground	100,000	
Heath Ranch	Constructed habitat	G surface & G ground	100,000	
Hancock	Constructed pool	G spring	100,000	
Goat Wall	Constructed pool	P surface & G ground		50,000
TOTALS	**1,000,000**		**637,500**	**362,500**

B. STEP 2 SITE EVALUATIONS

Future facility work supporting the Step 2 NPPC step review process will include the collection of data on high priority locations and their alternatives. Information such as the following will be collected and evaluated:

- Road access.
- Presence of listed species.
- Presence of survey and manage species.
- Proximity to natural coho spawning and rearing habitat.
- Water flow, temperature, and quality.
- 100-year flood elevations and topographic data.
- Ground water availability and withdrawal impacts.
- Land ownership and zoning.
- Environmental land conditions and previous uses.
- Other environmental data: Wetlands, Cultural resources, etc.

VI. *ATTACHMENTS*

1. COST COMPARISON DETAIL

These cost estimates were used to evaluate acclimation system options.

a. Capital

Recent acclimation projects (see the table below) in the region are used for capital cost estimating purposes. Although they are not all coho facilities, a capacity for each site using similar criteria (5.4 smolts per cubic ft of rearing volume, or .3 lbs/ft^3, or a DI of .05) is calculated in the last column for comparison purposes. Costs are for construction only.

Table 7. Acclimation Sites Used for Cost Estimating

ACCLIMATION SITE	Type	Size (cft)	Construction Cost (2005 $)	Coho Capacity
Coulter	Existing natural pond, gravity flow	20,000	$5,000	100,000
Rohlfing	Constructed pool, gravity flow	36,000	$20,000	120,000
Carlton	Constructed acclimation facility, pumped	53,000	$780,000	176,667
Twisp	Constructed acclimation facility, gravity flow	22,000	$470,000	73,333
Chief Jo (ea)	Constructed acclimation facility, pumped	53,000	$590,000	176,667
Dungeness	Constructed natural habitat, gravity	87,000	$400,000	20,000
Cle Elum (ea)	Concrete raceways, pumped	27,000	$1,600,000	145,800

Original costs are updated to 2005 dollars by assuming an annual interest rate of 3% (the historic, average, effective rate).

In the tables below (Table 7), site construction costs were estimated by scaling the above sample project costs to the various fish production capacities used in evaluating acclimation alternatives 1, 2, and 3. Table 8 shows the number of smolt releases per site for each alternative. A total release number of 2,000,000 was used in the evaluation. The scaling assumes that 40% of the construction costs are independent of numbers of fish acclimated (fixed costs include contractor bonding, equipment mobilization, etc.) and the other 60% are a function of fish production quantities. The scaling formula:

Table 7 Construction Cost =

(Table 6 Construction Cost)/[(0.4+(0.6 x Table 7 Fish Numbers)/Table 6 Fish Numbers]

is used to estimate the construction costs in Table 7. The accuracy of the formula can be demonstrated by applying it to constructed facilities of similar design with different production numbers.

Costs for design and contingencies for all sites are estimated to be 50% of construction costs. This includes engineering design (15%) and construction management (5%). Permit costs are assumed to be low for the existing ponds and higher for increasing amounts of construction. Permits include water rights, HPA, shorelines, critical areas, floodplain, wetlands, and local construction permits.

Land purchase costs, except for the constructed habitats, are assumed to average $250,000 for a 5-acre lot. This is a value derived from a survey done by Yakama Nation Fisheries staff of waterfront, undeveloped property sales in the region. In the areas where acclimation sites are proposed, 5-acre lot size minimums apply in most cases. The constructed habitats will need to be built on sites larger than 5 acres, lot sizes of 20 acres are assumed.

Facility permit costs are assumed to be $5,000 per site for the existing ponds and $10,000 per site for the constructed pools. The other alternatives, which require water supply and major rearing unit construction, are assumed to have $25,000 per site in permit costs. These permit and study costs were based on similar projects completed by the MCCRP and Yakama Nation in the recent past (see Appendix D).

Table 8. Typical Acclimation Site Capital Costs

DEVELOPMENT COSTS FOR SITES WITH A SMOLT CAPACITY OF: 182,000

ACCLIMATION TYPE	Design & Contingency	Permits	Land	Construction	**TOTAL**
Existing natural pond, gravity flow	$ 3,450	$ 5,000	$ -	$6,900	**$ 15,000**
Constructed pool, gravity flow	$ 12,500	$ 10,000	$ 250,000	$25,000	**$ 298,000**
Constructed acclimation facility, pumped	$ 397,000	$ 25,000	$ 250,000	$794,000	**$ 1,466,000**
Constructed natural habitat, gravity	$ 429,000	$ 25,000	$ 400,000	$858,000	**$ 1,712,000**
Concrete raceways, pumped	$ 908,500	$ 25,000	$ 100,000	$1,817,000	**$ 2,851,000**

DEVELOPMENT COSTS FOR SITES WITH A SMOLT CAPACITY OF: 91,000

ACCLIMATION TYPE	Design & Contingency	**Permits**	Land	Construction	**TOTAL**
Existing natural pond, gravity flow	$ 2,350	$ 5,000	$ -	$4,700	**$ 12,000**
Constructed pool, gravity flow	$ 8,400	$ 10,000	$ 250,000	$16,800	**$ 285,000**
Constructed acclimation facility, pumped	$ 249,250	$ 25,000	$ 250,000	$498,500	**$ 1,023,000**
Constructed natural habitat, gravity	$ 376,050	$ 25,000	$ 400,000	$752,100	**$ 1,553,000**
Concrete raceways, pumped	$ 587,650	$ 25,000	$ 100,000	$1,175,300	**$ 1,888,000**

DEVELOPMENT COSTS FOR SITES WITH A SMOLT CAPACITY OF: 61,000

ACCLIMATION TYPE	Design & Contingency	**Design & Permits**	Land	Construction	**TOTAL**
Existing natural pond, gravity flow	$ 1,800	$ 5,000	$ -	$3,600	**$ 10,000**
Constructed pool, gravity flow	$ 6,500	$ 10,000	$ 250,000	$13,000	**$ 280,000**
Constructed acclimation facility, pumped	$ 182,500	$ 25,000	$ 250,000	$365,000	**$ 823,000**
Constructed natural habitat, gravity	$ 335,000	$ 25,000	$ 400,000	$670,000	**$ 1,430,000**
Concrete raceways, pumped	$ 436,000	$ 25,000	$ 100,000	$872,000	**$ 1,433,000**

Values in the last column in Table 8, Capital Cost/Site, are taken from Table 7 above. Alternative 1 is existing natural ponds with gravity flow, Alternative 2 is constructed pools with gravity flow, and Alternative 3 is constructed acclimation facilities with pumped water supplies (see IV.B.2 for details).

Table 9. Acclimation Alternative Details

	# of Sites	# of Fish per Site	Capital Cost per site
Alternative 1	33	61,000	$10,000
Alternative 2	22	91,000	$285,000
Alternative 3	11	182,000	$1,466,000

b. Operating

Operating cost estimates are based on current program expenses. The 2006 MCCRP acclimation budget totals $220,866 (from the 2006 MCCRP Budget). The estimated budget for the year 2012 is $322,916 (see Appendix D). During 2006, 6 acclimation sites will be operated and in 2012, 18 will be operated. The cost of operating those 12 additional sites is $8,504 each. This cost per site value was used to make the calculation in the "Cost of Additional Sites" column in Table 9. This amount is added to the 2006 base price to estimate the total operating cost for each alternative.

Table 10. Alternative Acclimation System Yearly Operating Costs

	Number of Sites	2006 Acclimation Cost	Cost of Additional Sites	**TOTAL ACCLIMATION**
Current Program	6	$ 220,866	$ -	**$ 220,866**
Alternative 1	33	$ 220,866	$ 229,612	**$ 450,478**
Alternative 2	22	$ 220,866	$ 136,067	**$ 356,932**
Alternative 3	11	$ 220,866	$ 42,521	**$ 263,387**

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